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Middle Jurassic radiolarian assemblages from Zlatar Mt. (SW Serbia)

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Abstract. Detailed micropalaeontological research of Jurassic siliceous rocks was performed at the locality Komarani on the eastern flanks of the area of Mt. Zlatar in SW Serbia. According to the determined radiolarian associations, the investigated radiolarites are of Late Bajocian to Early Callovian age.

Key words: Middle Jurassic, radiolarians, Internal Dinarides, Komarani Village, SW Serbia.

Апстракт: На локалитету Комарани, на источним падинама планине Златар (ЈЗ Србија) извршена су детаљна микропалеонтолошка истраживања јурских силицијских седимената. На основу одређених радиоларијских асоцијасија утврђена је горњобајеска до доњокеловејска старост радиоларита локалитета Комарани.

Кључне речи: средња јура, радиоларије, Унутрашњи Динариди, село Комарани, ЈЗ Србија.

Introduction

The investigated area is situated in western Serbia, in an extremely complex geotectonic setting (Fig. 1). There are two belts of ophiolitic mélange in the territory of western Serbia. Petrographic and geochemical differences between the ophiolites of the two belts were used as evidence for the existence of two distinct oceanic basins, originally separated by one or several Adria-derived micro-continents (Robertson & Karamata 1994; Dimitrijević 1997 and Karamata 2006). The more external belt is known as the Dinaridic Ophiolite Belt (Pamić *et al*. 2002 and Karamata 2006) or the Central Dinaridic Ophiolite belt (Lugović *et al*. 1991), while the internal belt is known as the Vardar Zone Western Belt (Karamata 2006), Inner Dinaridic ophiolite belt (Lugović *et al.* 1991), External Vardar Subzone (Dimitrijević 1997, 2001) or simply the Vardar Zone (Pamić *et al*. 2002). This "two ocean" model contrasts with that of Pamić (1998), Pamić *et al*. (2000), Csontos *et al*. (2003) and Schmid *et al*. (2008), who suggested that both ophiolitic belts originated in a single ocean. Schmid *et al*. (2008) considered the two belts of ophiolites as relics of the same, formerly coherent ophiolitic sheet (their Western Vardar Ophiolitic Unit) that was obducted onto the Adriatic passive margin in the Late Jurassic. Parts of the Adriatic margin, which occur below the ophiolitic units in the form of windows, were interpreted as microcontinents by earlier authors.

The ophiolite belts in western Serbia are separated by the Drina–Ivanjica Unit. The majority of authors regarded the Drina–Ivanjica Unit as a continental terrane that was originally located between two separate oceanic basins (Dimitrijević & Dimitrijević 1973; Robertson & Karamata 1994; Dimitrijević 2001; Karamata 2006). Others were of the opinion that this element was formed by out-of-sequence thrusting from the European margin (Pamić *et al*. 1998; Pamić & Hrvatović 2003). According to Schmid *et al*. (2008), the Drina–Ivanjica is a thrust sheet which was probably emplaced on top of the East Bosnian–Durmitor thrust sheet in the Early to mid-Cretaceous times. Similar to the East Bosnian-Durmitor composite thrust sheet, the Drina–Ivanjica thrust sheet passively carried the previously obducted Western Vardar ophiolites (Zlatibor ophiolites).

Due to the tectonic position of the investigated area, this paper is an important contribution to a bet-

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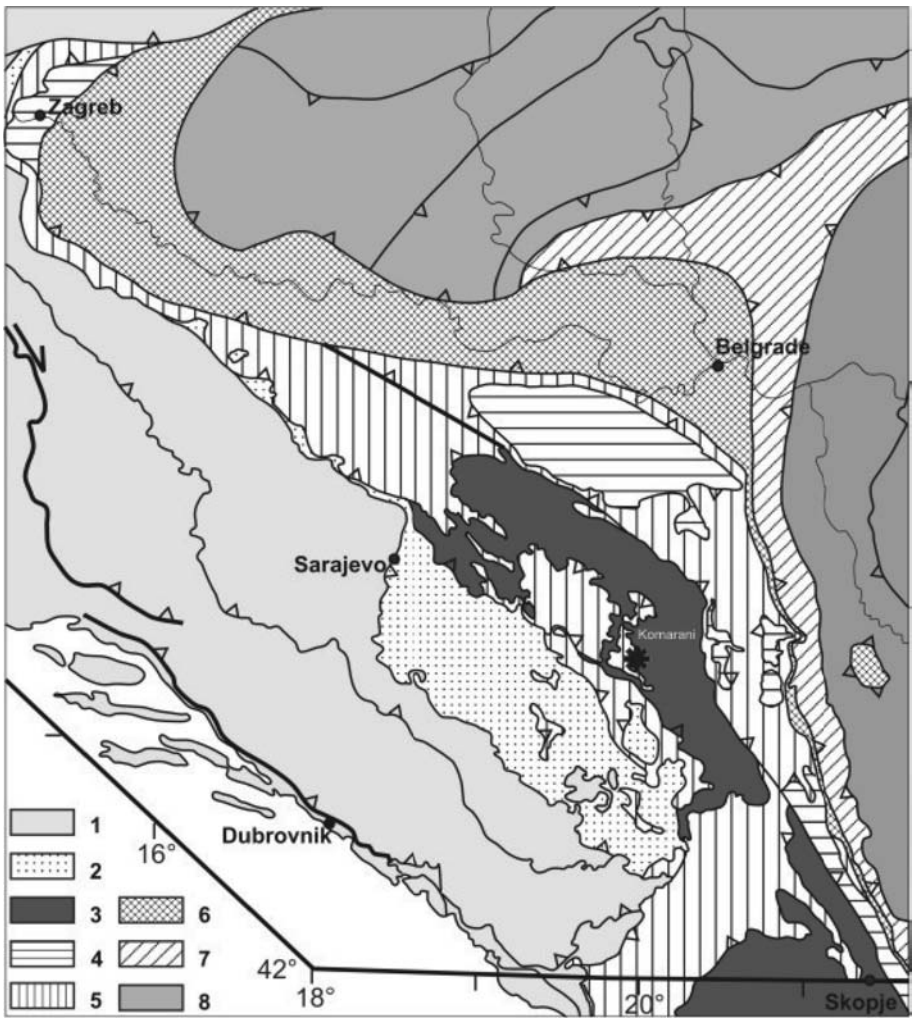

Fig. 1. Tectonic sketch of the Dinarides (after SCHMID *et al.* 2008), indicating the position of the studied locality. The units mapped are, from external to internal: **1,** External Dinarides (without subdivisions); **2,** East Bosnian–Durmitor Unit; **3,** Drina Ivanjica Unit (parallelized with the Korab Unit of Albania or the Pelagonian Massif of Greece, part of the Internal Dinarides); **4,** Jadar and Kopaonik blocks (part of the Internal Dinarides); **5,** Dinaridic and Western Vardar ophiolites (parallelized with the Mirdita ophiolites of Albania, obducted onto the internal Dinarides in Jurassic times); **6,** Sava Belt (Paleogene suture zone); **7,** Eastern Vardar Ophiolites; **8,** "European" units (Tisza-Dacia and Carpatho-Balkan).

ter understanding of the geological evolution of the area, which will enable comparison with similar rocks in the surrounding regions.

Geological setting

Very thick Jurassic radiolarite successions are typical for the area of the Zlatar Mt. A widely accepted opinion among Serbian geologists is that the association of siliceous rocks (cherts and radiolarites) that belong to the Zlatar Formation represents a sedimentary cover of an oceanic crust (RADOVANOVIĆ 1987, 2000). According to other opinions, Jurassic radiolarites are not necessarily a part of an *in situ* preserved stratigraphic cover of an ophiolitic sequence, but that they could also occur as gravitationally emplaced olistoliths or olistoplake (DIMITRIJEVIĆ 1997), or as tectonically incorporated slices torn off the Adriatic margin and incorporated into the mélange below the obducted ophiolite (DJERIĆ *et al*. 2007a; SCHMID *et al*. 2008). The third, largest group includes radiolarite strata deposited onto the drowning passive margin of the Adria (East Bosnian–Durmitor nappe and Drina–Ivanjica thrust sheet) (DJERIĆ *et al*. 2007a).

The radiolarites found at the locality Komarani could be a part of the ophiolitic mélange that structurally underlies the ophiolites of the Dinaridic Ophiolite Belt (KARAMATA *et al*. 1997). Alternatively, they could also represent the matrix (could also be a block in the mélange) of the mélange formation of the East Bosnian–Durmitor Unit (DJERIĆ *et al*. 2007b).

Material and Methods

The described radiolarian assemblages originated from one single section at the Komarani Village (Fig. 1). Four samples were taken from the radiolarites at the locality Komarani, but only two were positive. The chert samples were treated only with dilute 5–7 % hydrofluoric acid, following the method of PESSAGNO & NEWPORT (1972). In all samples, nassellarians were much more abundant than spumellarians. The residues of the acid treatment, which yielded well preserved faunas, were studied for biostratigraphic purposes. In order to establish the age of the radiolarian assemblages, the zonation schemes proposed by BAUMGARTNER *et al*. (1995) were used. An SEM microscope ISI-160 in GIN RAN (Moscow) was utilized for the precise identification and illustration of the radiolarians. These are illustrated in Plate 1. The micropaleontological material is housed at the Faculty of Mining and Geology in Belgrade (registration numbers NĐ 328 and NĐ 329).

Section description and biostratigraphy

The locality is, actually, an abandoned chert quarry in the Komarani Village, by the road Nova Varoš––Akmačići–Komarani–Pavlovića Brod (x = 7411117, y = 4811144). The investigated section is composed of alternating thin-bedded silicified siltstone and dark brown to black thin- to medium-bedded radiolarite. Siltstone is the predominating rock. The actual thickness of the radiolarite in this section can not be determined because the layers are extremely tectonically deformed. These radiolarites might belong to the ophiolitic mélange situated below the ophiolites of the Dinaridic Ophiolite Belt (KARAMATA *et al*. 1997). On the other hand, the radiolarites might be the matrix of the mélange in the East Bosnian–Durmitor Unit (DJERIĆ *et al*. 2007b).

Four samples were taken from the radiolarites in the quarry, but only two were positive.

Sample NĐ 328 was taken from dark brown, thin-bedded, partly clayey radiolarite. The fauna is sparse, poorly preserved, with mostly broken or deformed forms. The following species were identified: *Triversus hungaricus* (KOZUR), *Cinguloturris getsensis* O'DOGHERTY, GORIČAN & DUMITRICA, *Eucyrtidiellum* sp. cf. *E. semifactum* (NAGAI & MIZUTANI), *Unuma* sp. cf. *U. gordus* HULL, *Williriedellum* (?) sp. and *Hiscocapsa* sp. (Plate 1).

The uppermost Bajocian to Early Callovian (UAZs 5–7) age of the chert is based on the identified *Eucyrtidiellum* sp. cf. *E. semifactum*.

Sample NĐ 329 was taken from glassy, dark gray compact radiolarite. The radiolarian association is abundant and versatile. The following species were identified: *Dictyomitrella* ? *kamoensis* MIZUTANI & KIDO, *Eucyrtidiellum unumaense s.l.* YAO, *Williriedellum tetragona* (MATSUOKA), *Protunuma* ? *ochiensis* MATSUOKA, *Williriedellum* sp. aff. *W. yaoi* (KOZUR), *Williriedellum carpathicum* DUMITRICA, *Stichocapsa japonica* YAO, *Unuma gordus* HULL, *Unuma* sp. cf. *U. gordus*, *Triversus kasinzovae* VISHNEVSKAYA, *Stichocapsa* sp., *Protunuma* sp., *Unuma* sp., *Dictyomitrella* sp., *Xitus* (?) sp. i *Zhamoidellum* sp. (Plate 1).

Late Bathonian to Early Callovian age (UAZ 7) was established according to the presence of *Dictyomitrella* ? *kamoensis* (UAZs 3–7; BAUMGARTNER *et al*., 1995) and *Williriedellum carpathicum* (UAZs 7–11; BAUMGARTNER *et al*., 1995).

Final remarks

Siliceous deposits from the Komarani locality consist of radiolarian cherts with clay and silicified siltstone. Based on the radiolarians, the analyzed cherts were deposited between the Latest Bajocian and Early Callovian. The radiolarian association in the sample NĐ 329 is more abundant and versatile, thus it indicates a shorter time interval – Late Bathonian to Early Callovian. Radiolarites that represent the matrix (could also be a block in the mélange) were also observed in a nearby locality Abeško Brdo (area of Sjenica, SW Serbia). The age of the radiolarites from the locality Abeško Brdo is compatible with the age of the siliceous sediments in the locality Komarani (Callovian; GAWLICK *et al*. 2009). The radiolarian associations from the locality Komarani are correlatable with the radiolarian associations identified from sediments of the central Pontides in northern Turkey (BRAGIN *et al*. 2002), in the West Carpathians (RAKUŠ & OŽVOLDOVA 1999), as well as with the Upper Bajocian to Oxfordian associations from the sedimentary cover of ophiolites in Albania (MARCUCCI *et al.* 1994). Similar radiolarian associations are known from a locality on the Mangart Mt. in Slovenia (ŠMUC & GORIČAN 2004), the Medvednica Mt. in NW Croatia (HALAMIĆ *et al*. 1999), as well as from the Mirdita area in Albania (CHIARI *et al*. 1994; PRELA 1994).

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Резиме

Средњојурске радиоларије планине Златар (ЈЗ Србија)

Силицијске седиментне стене, представљене рожнацима и радиоларитима, широко су распрострањене у Србији. Најчешће су присутне у унутрашњим деловима Динарида, у оквиру офиолитских појасева и/или са формацијама офиолитског меланжа, ређе у другим геолошким срединама. Рожнаци и радиоларити Србије формирани су у различитим условима, од подножја континенталне падине до абисалних делова, у дубокоморском рову и у континенталним рифтовима. Максимум акумулације рожнаци и радиоларити достижу у средњем и горњем тријасу, као и током средње и горње јуре.

На локалитету Комарани који се налази поред пута Нова Варош–Акмачићи–Комарани–Павловића Брод (x = 7411117, y = 4811144) откривен је профил танкоуслојених силификованих алевролита и тамнобраон до црних танко до средње услојених радиоларита. Стварна дебљина радиоларита и алевролита на овом профилу се не може установити јер су слојеви тектонски јако поремећени. Према RADOVANOVIĆ (1987) рожнаци и алевролити локалитета Комарани представљају члан Формације Златара Динаридског офиолитског појаса. Наведени аутор сматра да асоцијације силицијских стена са сливовима базалтних вулканита ове формације нису обухваћене процесом меланжирања. Према DJERIĆ *et al*. (2007b) истраживани седименти највероватније представљају матрикс (блок?) меланжа Источнобосанско-дурмиторске јединице.

Из радиоларита Комарана узете су 4 пробе, али су само 2 дале позитивне резултате:

Проба НЂ 328 – Фауна је ретка, углавном слабо очувана и већина примерака је поломљена или деформисана. Старост рожнаца је горњи бајес (највиши делови) до доњи келовеј (UAZs 5-7) и одређена је на основу присуства врсте *Eucyrtidiellum* sp. cf. *E. semifactum* (NAGAI & MIZUTANI).

Проба НЂ 329 – Асоцијација радиоларија је бројна и разноврсна. Горњобатска до доњокеловејска старост (UAZ 7) одређена је на основу присуства *Dictyomitrella* ? *kamoensis* (UAZs 3-7; BAUMGARTNER *et al*. 1995a) и *Williriedellum carpathicum* (UAZs 7-11; BAUMGARTNER *et al*. 1995a).

Сличне средњојурске радиоларијске асоцијације познате су и из локалитета Абешко брдо, ЈЗ Србија (GAWLICK *et al*. 2009), планине Мангарт, Словенија (ŠMUC & GORIČAN 2004), планине Медведница, СЗ Хрватска (HALAMIĆ *et al.* 1999), Мирдита подручја у Албанији (CHIARI *et al*. 1994; PRELA 1994), као и западних Карпата (RAKUŠ & OŽVOLDOVA 1999).

PLATE 1
Middle Jurassic radiolarians from the Komarani locality.
Scale bar = 50 μm (Figs. 1–6, 8, 10–22, 24–29); = 20 μm (Fig. 7); = 100 μm (Figs. 9, 23).

Figs. 1, 2. *Triversus hungaricus* (KOZUR), sample NĐ 328.

Fig. 3. *Cinguloturris getsensis* O'DOGHERTY, GORIČAN & DUMITRICA, sample NĐ 328.

Fig. 4. *Williriedellum* (?) sp., sample NĐ 328.

Fig. 5. *Hiscocapsa* sp., sample NĐ 328.

Fig. 6. *Unuma* sp. cf. *U. gordus* HULL, sample NĐ 328.

Fig. 7. *Eucyrtidiellum* sp. cf. *E. semifactum* (NAGI & MIZUTANI), sample NĐ 328.

Fig. 8. *Dictyomitrella* sp. cf. *D. kamoensis* MIZUTANI & KIDO, sample NĐ 329.

Fig. 9. *Dictyomitrella kamoensis* MIZUTANI & KIDO, sample NĐ 329.

Figs. 10, 11. *Triversus kasinzovae* VISHNEVSKAYA, sample NĐ 329.

Figs. 12, 13. *Xitus* sp., sample NĐ 329.

Figs. 14, 15. *Eucyrtidiellum unumaense s. l.* (YAO), sample NĐ 329.

Fig. 16. *Stichocapsa* sp., sample NĐ 329.

Fig. 17. *Stichocapsa japonica* YAO, sample NĐ 329.

Fig. 18. *Williriedellum* sp. cf. *W. tetragona* (MATSUOKA), sample NĐ 329.

Fig. 19. *Williriedellum tetragona* (MATSUOKA), sample NĐ 329.

Fig. 20. *Williriedellum* sp. aff. *W. yaoi* (KOZUR), sample NĐ 329.

Fig. 21. *Williriedellum carpathicum* DUMITRICA, sample NĐ 329.

Fig. 22. *Zhamoidellum* sp., sample NĐ 329.

Fig. 23. *Arcanicapsa* (?) sp., sample NĐ 329.

Fig. 24. *Hiscocapsa* (?) sp., sample NĐ 329.

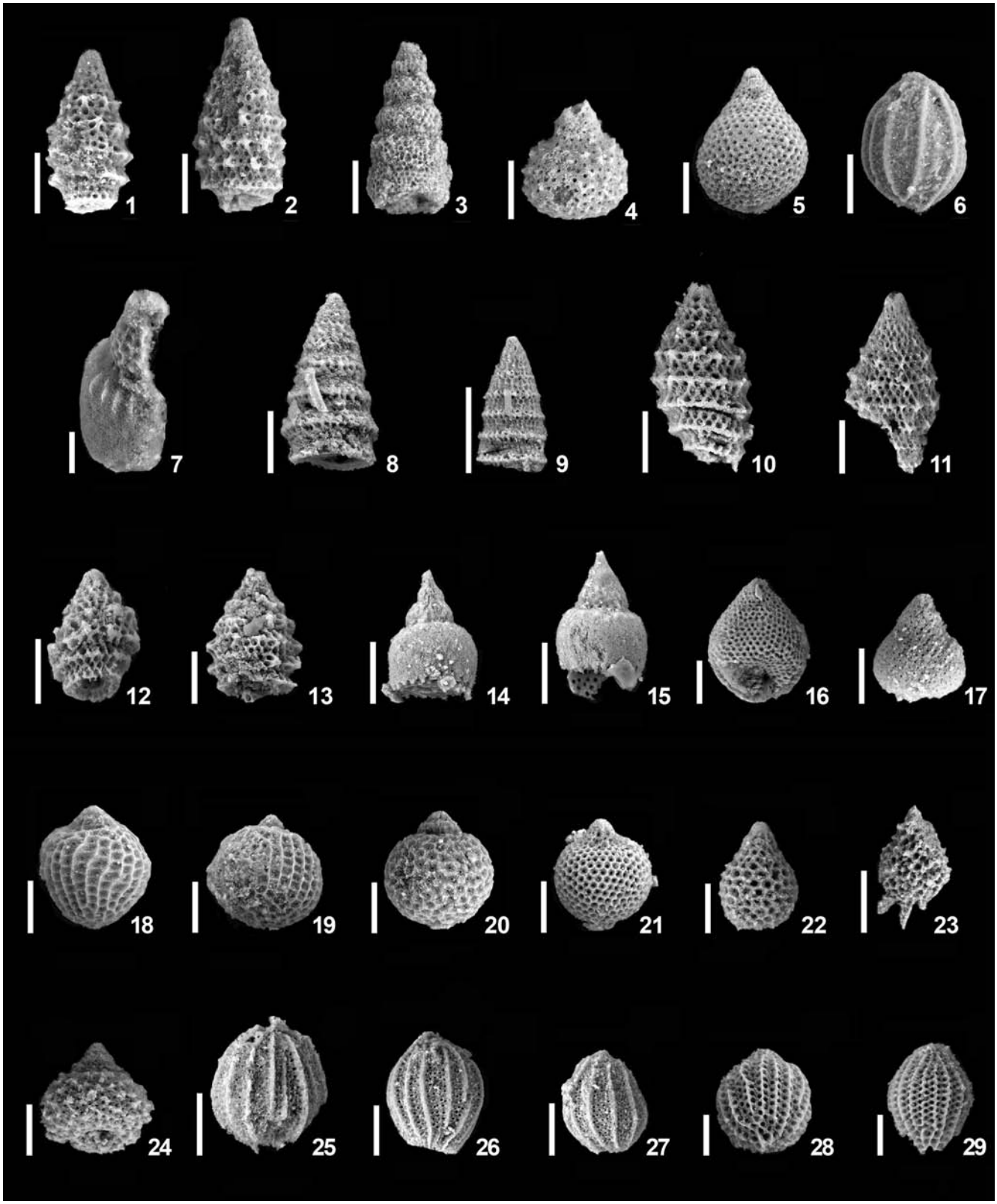
Fig. 25. *Unuma* sp., sample NĐ 329.

Fig. 26. *Unuma* sp. cf. *U. gordus* HULL, sample NĐ 329.

Fig. 27. *Unuma gordus* HULL, sample NĐ 329.

Fig. 28. *Protunuma ochiensis* MATSUOKA, sample NĐ 329.

Fig. 29. *Protunuma* sp., sample NĐ 329.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